JOURNAL OF MECHANICAL AND TRANSPORT ENGINEERING
Vol. 70, No. 1 2018
DOI 10.21008/j.2449-920X.2018.70.1.01

Tomasz BERNAT*
Aleksandra REWOLIŃSKA*
(Received 9 Nov 2017, Received in revised form 12 Feb 2018, Accepted 5 Jun 2018)

ANALYSIS OF TECHNICAL READINESS OF BUSES IN SELECTED TRANSPORTATION COMPANY

The purpose of the study was to present and compare the technical readiness indicators of selected vehicles in the transport company.The study was done taking into account the sample of public transport vehicles. The calculation of the readiness coefficient of the tested buses was made. The results of the research are compiled according to age and mileage. After the analysis of the results, it was found that the readiness coefficient does not depend directly on the age and the mileage of the vehicle.

Key worlds:technical readiness, public transport, bus

1. INTRODUCTION

At present, the European Union strictly regulates the law for transport companies (Official website of the European Union, 2017), and especially to companies related to passenger transport (Regulation (EC) No 1071/2009 of the European Parliament and of the Council, Regulation (EC) No 1073/2009 of the European Parliament and of the Council). In addition, these companies must comply with the regulations imposed by the Polish state (Journal of Laws 2011 No. 5, item 13).Among other things, they must comply with safety requirements regarding the necessary permits and licenses and the quality of the services provided. If the above criteria are met company with activities in the urban transport sector must also carry out proper maintenance and repair plans (Niziński and Michalski, 2007).

The aim of this article is to evaluate the technical readiness of selected city buses operating in a transport company.

* Poznan University of Technology, Faculty of Machines and Transport.

2. RESEARCH OBJECT

Implementation of legal requirements in the field of transport is one of the factors that enable a company. Another factor is the care of its fleet, which manifests itself in the servicing and repair plans. In the analyzed company the basic system of servicing and repair is operating according to state and as a complement to the master plan of the operating system is also used preventive plan.

The study transport company in 2015 operated using 40 vehicles. Of these 31 are city buses, 6 are vehicles for the transport of disabled people, and the other 3 are commercial vehicles.

Table 1.List of buses selected for testing

Group	Mark	Bus number	Year of production	Total mileage [km]	Mileage in 2015 [km]
I	Neoplan	1	1995	849506	21841
		2	1995	726692	20941
		3	1999	938644	45156
		4	2000	975295	56708
II	MAN	5	1994	907921	15396
		6	1998	832378	30621
		7	2000	863675	49371
		8	2001	783684	42368
		9	2002	768344	44580
III	Solaris	10	2003	1192614	56350
		11	2012	241892	76428

Only city buses were used in research. Of the 31 buses 11 were selected. This group of vehicles was chosen because they were characterized by the most reliably maintained service history and repairs. They were grouped into three groups (Table 1). The first two groups are Neoplan and MAN buses, while the third group includes Solaris vehicles, which differ significantly in age or mileage from the rest. The study took place between 01.01.2015 and 31.12.2015. Graphical comparison of the overall mileage and mileage in 2015 of the examined group of buses is shown in Fig. 1.

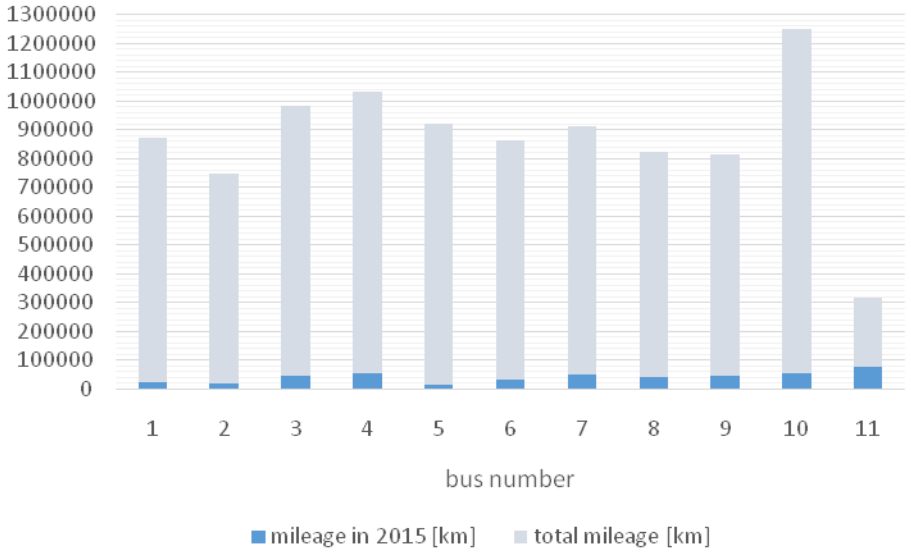

Fig. 1. Total mileage and mileage in 2015 of a selected vehicle group

3. RESEARCH ANALYSIS

To determine the readiness coefficient of bus companies (equation 1) and the group of buses studied by the company (equations 2 and 3), the models were taken from the subject literature (Leończuk, 2011).

$$Wc = \frac{\sum_{i=1}^{11}(Wv_i \cdot LM_i)}{LF} \tag{1}$$

where:
Wc – readiness coefficient of bus company,
Wv_i– vehicle "i" readiness coefficient,
i – bus number,
LM_i – number of vehicles from the given model in the company,
LF – number of buses in the company.

$$Wv_i = \frac{L_{2015} - LP_i}{L_{2015}} \cdot 100\% \tag{2}$$

where:
Wv_i – vehicle readiness coefficient,
i – bus number,

L_{2015} – number of days in 2015 (value: 365),
LP_i – the number of days the vehicle "i" is stationary in 2015.

$$Wg_j = \frac{\sum_i^n Wv_i}{n} \quad (3)$$

where:
Wg_j – group of vehicle readiness coefficient,
j – number of group,
Wv_i – vehicle readiness coefficient,
i – bus number,
n - number of vehicles in the group "j".

Using the equations above, the readiness coefficients of the examined group of buses were determined (Table 2).Taking into account information on the number of vehicles from a given model, with using equation 1, the company has determined the readiness factor for all vehicles of the company, which is 85%.

Table 2. Technical readiness coefficients for individual buses and groups

j	-	i	LM_i	LP_i	Wv_i	Wg_j
Group	Mark	Bus number	**The number of vehicles from a given model in the company**	**The number of days the vehicle is stationary in 2015**	**Readiness coefficient [%]**	**Readiness coefficient of the group [%]**
1	Neoplan	1	6	49	87	89
		2	1	18	95	
		3	1	52	86	
		4	1	42	88	
2	MAN	5	5	93	75	80
		6	2	97	73	
		7	2	47	87	
		8	2	22	94	
		9	1	104	72	
3	Solaris	10	1	78	79	87
		11	6	20	95	

Presented readiness coefficient for groups I and II are 89% and 80% respectively. In group III, vehicles of the same brand were assembled but definitely differed by age and mileage. These significant differences are also apparent for the predicted readiness coefficient.

In order to determine the effect of the age, mileage in 2015 year and total mileage of the selected vehicles on the readiness coefficient, the results in Fig. 3, 4 and 5 are presented.

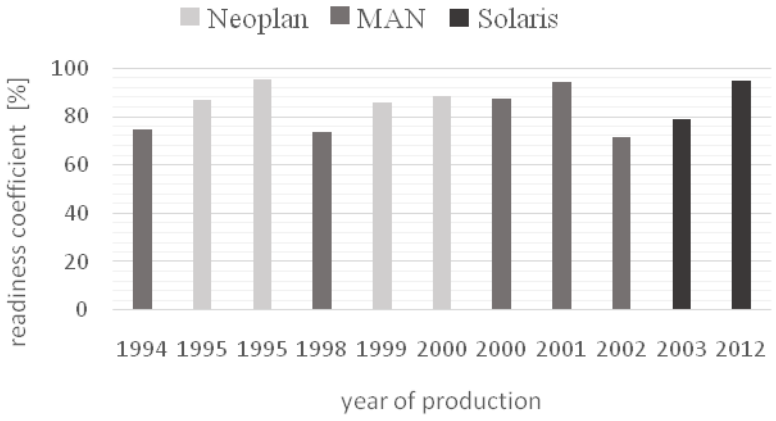

Fig. 3. Readiness coefficient of tested vehicles according to the year of production

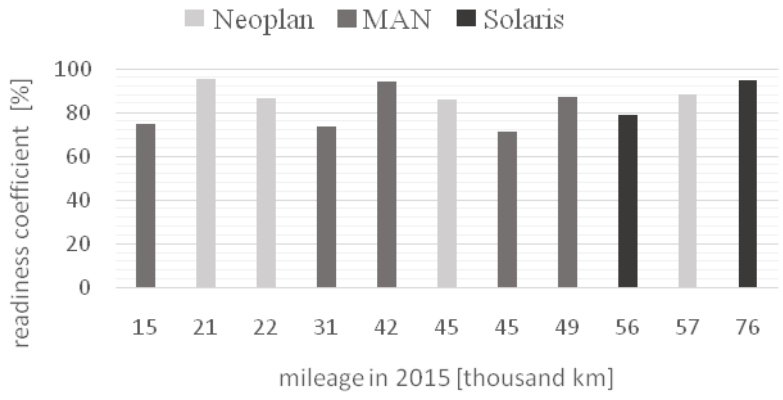

Fig. 4. Readiness coefficient of the vehicles tested according to mileage in 2015

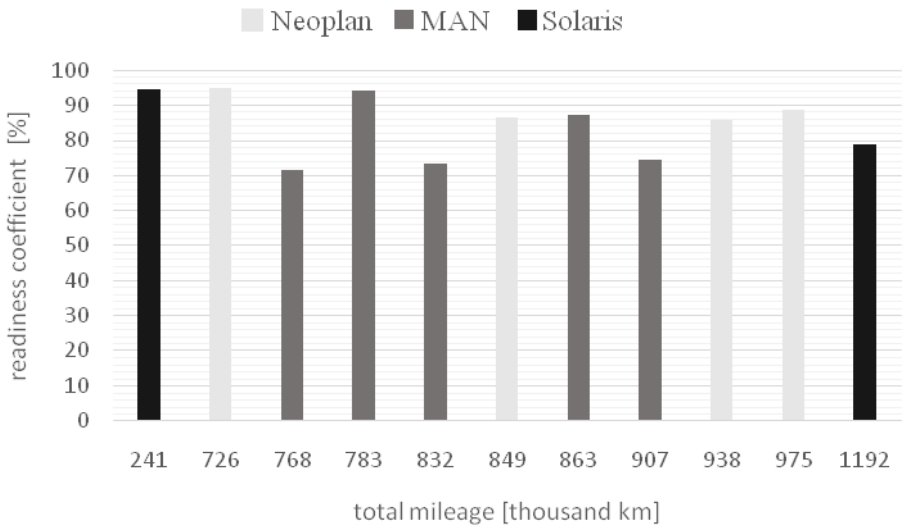

Fig. 5. Readiness coefficient of the vehicles tested according to total mileage

To illustrate the reasons for the most frequent bus stops, a vehicles with the most accurate documentation of the service was selected, ie buses from groups 1 to 3 (Fig. 5).

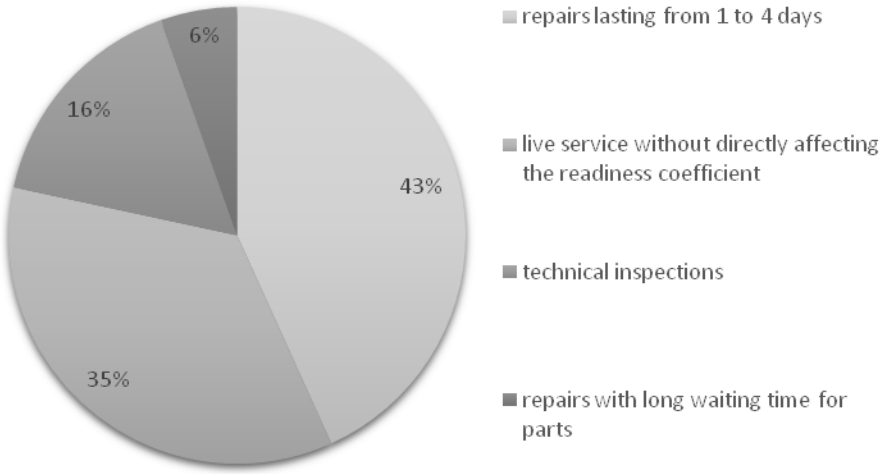

Fig. 5. The causes of downtime buses

From the above figure it shows that the most common reason for downtime repairs were lasting from one to four days. The second most important reason was maintenance and repairs, without directly affecting the readiness coefficient, i.e. those that were performed when the bus stopped at the depot and when there was no need for it.The remaining values were related to the necessary technical inspections, i.e. periodical inspections OT-1, OT-2 and periodical technical inspections. The smallest share of the reasons for stops was dependent on the time required to obtain spare parts.

4. CONCLUSIONS

The research made the following conclusions:

– despite the use of the same servicing and repair plans for each brand, a better readiness coefficient belongs to group I,

– it is difficult to determine the direct impact of vehicles slightly different in mileage and age on the readiness coefficient,

– with a significant difference in age and mileage in group III, there is a large difference in technical readiness,

– the most common causes of downtime resulted from vehicle repairs lasting from one to four days.

REFERENCES

Journal of Laws (2011). No. 5, item 13. *Act of 16 December 2010 on Public Mass Transit*.

Leończuk D. (2011). Road transport of goods in Poland. *Economics and Management*, p. 98-108.

Niziński S., Michalski R. (2007). *Maintenance of vehicles and machines.* Olsztyn: University of Warmia and Mazury.

Official website of the European Union (2017). Downloaded from https://europa.eu/european-union/topics/transport_pl.

Regulation (EC) No 1071/2009 of the European Parliament and of the Council. *Common rules concerning the occupation of road transport operator*.

Regulation (EC) No 1073/2009 of the European Parliament and of the Council. *Common rules for access to the international market for coach and bus services*.

ANALIZA GOTOWOŚCI AUTOBUSÓW W WYBRANYM PRZEDSIĘBIORSTWIE TRANSPORTOWYM

Streszczenie

Celem badań było przedstawienie oraz porównanie wskaźników gotowości technicznej wybranych pojazdów w przedsiębiorstwie transportowym. Badania wykonano biorąc pod uwagę próbę pojazdów komunikacji miejskiej. Wykonane zostały obliczenia współczynnika gotowości badanych autobusów. Wynik obliczeń zestawiono w zależności od wieku i przebiegu. Po przeprowadzonej analizie wyników, stwierdzono, że współczynnik gotowości nie zależy bezpośrednio od wieku i przebiegu pojazdu.

Słowa kluczowe: gotowość techniczna, komunikacja miejska, autobus